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Page 1/1

## Title:

Asteroid 1950 DA: Long Term Prediction of its Earth Close Approaches

Oral presentation preferred (presenter to be J. Giorgini)

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With a 51-year observation baseline and a robust set of recent high precision Arecibo and Goldstone radar astrometry measurements, 1950 DA has one of the best defined orbits of any of the near-earth asteroids. Furthermore, this object has dynamical properties which constrain the growth of its orbit uncertainty over time. As a result, 1950 DA's orbital motion can be predicted with reasonable accuracy over many hundreds of years. These conclusions are possible in large part due to the recent high precision radar astrometry measurements. Orbit solutions based on the optical data alone provide substantially less insight into long-term motion.

1950 DA, a spheroidal 1 km asteroid, was discovered February 23, 1950, at Lick Observatory. It was observed for 17 days, then lost. Rediscovery by LONEOS occurred Dec 31, 2000. The new observations were reported in MPEC 2001-A22 under the designation 2000 YK66. Two hours later, C.M. Bardwell, in MPEC 2001-A26, identified 2000 YK66 as being the long-lost 1950 DA.

Radar observations at Arecibo and Goldstone were carried out in March 2001, on dates that encompassed the asteroid's 21 lunar distance (LD) Earth close-approach on March 5. This was its closest approach to any major body in at least several hundred years, and until a pair of Earth approaches to about 14 LD in 2105 and 2187. The asteroid's minimum possible miss distance decreases over subsequent centuries, reaching 6 LD in the 2600s, and less than 1 LD in the 2800s.

During the radar experiment, linear analysis showed close approach circumstances that changed as radar data accumulated. Preliminary Monte Carlo analysis with 10000 possible trajectories suggest that 1950 DA's Earth encounter in 2880 might be extremely close but, despite the strong data set, little more can be concluded at the time of this writing since orbital propagation over such a long period may be sensitive to perturbations not yet included in our computations.

These omitted effects include planetary ephemeris uncertainties, thermal/solar radiation models and possibly additional perturbing asteroids. Results to be presented in this paper will address these issues with dynamical modeling, covariance and Monte Carlo sensitivity studies, currently in progress, to assess the validity of long-term close-approach predictions.